Asian Economic and Financial Review
ISSN(e): 2222-6737/ISSN(p): 2305-2147

journal homepage: http://www.aessweb.com/journals/5002

# EVALUATION OF PARTICLE SWARM ALGORITHM AND GENETIC ALGORITHMS PERFORMANCE AT OPTIMAL PORTFOLIO SELECTION

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## ABSTRACT

*This research aims to evaluate the optimum portfolio selection using with particle swarm algorithm and genetic algorithm. For this purpose, the financial information of companies listed on the Iran stock exchange, during years 2007 to 2012 is collected and using heuristic particle swarm algorithm, genetic algorithms and based on Markowitz model, mean-variance model and client risk model, generating optimal portfolio from the stocks has been investigated. In total, the results of this study showed that use of these algorithms can provide solutions both close together and close to optimality, and causes confidence of the investors' investment for making decisions. Also, based on the response obtained by performing several experiments it can be claimed that in Markowitz and mean-variance models can provide most optilam portfolio. In other hands, particle swarm algorithm is best in client risk model. Most observations reflect the fact that in the problems which are smaller and lighter the genetic algorithm, and as the complexity and size increases, the particle swarm algorithm perform better.*



**Keywords:** Portfolio**,** Genetic algorithms, Particle swarm algorithm, Markowitz model, Mean-variance model, Client risk model.

**JEL Classification:** G11, C61, C69.

## 1. INTRODUCTION

The literature can be significantly financial portfolio composition or set of the stock chosen by the investment to the investment, he said. The portfolio optimization of stock problems in in early 1952 was taken into account.

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DOI: 10.18488/journal.aefr/2015.5.1/102.1.88.101
*ISSN(e): 2222-6737/ISSN(p): 2305-2147*

Two important components in the investment decision are risk and return of the capital assets. Modern The portfolio theory, which was first introduced by Markouitz paradigm organizing the formation of the portfolio with the highest and Expected Returns on a given level of risk or set up an efficient set.

According to Markouitz's theory, one can by minimizing risk for a given level of return on investment to a minimum variance portfolio. In this case, a new approaches, using of optimization initiatives.

Heuristics that aims to overcome the shortcomings of classical of optimization were introduced, the exhaustive search and random, the probability to achieve better results largely guarantee. Today, according the limited resources and the risk of investing in of financial assets, one major problem is that the utility of each investment to determine a set of stock portfolio the majority of it is too much. This is equivalent to selecting the optimal portfolio from the set of possible portfolios. and the investment The portfolio of investors in the set a capital asset ment that at the lowest risk, highest efficiencies have for for this purpose, to should be on a model of optimal the portfolio choice in can help.

So far, several models have been proposed to solve the problem optimal portfolio according to conditions and limitations of each end are designed. Although theoretically as these models are solved using mathematical programming, but in practice there are problems with this area. Ment fund managers also in practice some of the limitations exercised upon their optimal portfolio that also cause this the problem more complex. Due to problems today ultra schematize Initiative of excessive method of solving optimization problems formation is taken into consideration. Indeed, choosing a financial portfolio in order to maximize efficiency, one of the major concerns of investors in financial markets. In fact, portfolio selection in financial markets in order to maximize efficiency, one of the major concerns of investors in financial markets. The goal of this optimization is to determine the allocation of financial capital in a way that yields the maximum total assets and a risk is minimal.

In general, the classical methods in selecting the optimal portfolio is not efficient enough, and now solve this problem, heuristic algorithms, including algorithms for of collective intelligence and a genetic algorithms, have been also considered. Collective Intelligence or groups of particles algorithm and a genetic algorithm can optimize the portfolio to maximize returns and a minimize risk of investment to solve. This algorithm can be as algorithm as the core population and improve the long history of study in literatures of Optimization. Accordingly, given the importance of this issue, the present study aimed to compare the performance of genetic algorithm (GA) and a particle swarm optimization portfolio (PSO) selection with respect to various constraints to investment in the stock portfolio.

In this context, this paper has five sections. The second section investigates the background of the research, including theoretical background and experimental research focus background. In the third section, the research methodology is presented in which the model used in this research study

will be discussed and analyzed. The fourth and a final section deals with the experimental results of this research study is devoted to the conclusions and presenting suggestions.

## 2. BACKGROUND RESEARCH

### 2.1. Theoretical Background

Markowitz (1952), the fundamental model of modern portfolio theory was offered portfolio. The Markowitz mean-variance model (MV), showed the formation of a basket of assets, there is financing is the possibility that a certain level of efficiency and reduced risk. This model was originally proposed for the measure risk taking. The optimal portfolio selection problem in two, appropriate model selection and efficient and effective method to achieve the optimal solution are very important. Usually, the traditional mathematical methods and algorithms for solving these models are not appropriate and accurate solutions for this kind of problem, mathematical programming algorithms effective and efficient programs exist (Fernandez and Gomez, 2007).

Genetic algorithm is one of the most random Metaheuresteky algorithms that science itself has provided acceptable results. The algorithm for the first time by Holland (1975a) proposed strategy and plan by other evolutionary Goldberg (1989), Fichter (2000), Fugl-Meyer *et al.* (1975) and a Lazo *et al.* (2000), was proposed.This algorithm is based on biology approach consists of Chromosomes that the genetic processes of living beings will act. Each chromosome display a collection of important information that character shows that the organism. To help of such a movement, every of chromosome is able to incorporate Necessary information to evaluate every problem. Every of chromosome is composed of smaller units called genes have. Of the matrix, every offering a chromosome and each of chromosomes is made up of cells that is gene. Create initial population of the genetic algorithm, which started in three steps: edged orientation, pair formation and mutations. This population-based algorithm is an algorithm which must coincide with the number resolve to start the search space. If you call the number n of the population, then there will be independent chromosomes. Often produce initial population is determined as follows:

$$X_i = Lower + (Upper - Lower) * random \quad (2\text{-}1)$$

Where x by multiplying a random number in the range of zero and a range of low, will be created. The general formula the construction of every gene on of chromosome different. The best of chromosome elitism at step, two parents are selected and fertilization takes place among them. There are different ways to select the best of the most popular, choosing a as a percentage of the the elite. Generally numbers between 5 to 10 percent of community leaders to assume In this case is enough for the greats, both parent and a child are selected. In practice, the measure mates between two living species occur in nature, as their parents are the genetic composition of offspring. The genetic the properties of gene exchange between parents takes place For this purpose a number of genes from each parent are selected and the new chromosomes replaced by of In this egg fertilization pairs of chromosomes, creates two children are in healthy, can result in reproduction or are incomplete. In this case, two differential behaviors can occur imperfect their children, including the health reform or miscarriage is the up to.

Since of previous population is dependent mates and a can only partly be compared to its distinctive, to avoid the trap of imprisonment is required local the optimality. So to avoid the trap of imprisonment is required local the optimality.

Purpose of this step is to establish the real distinctions between different regions of space in the search the answer, it could be claimed. For this purpose, first of chromosome is chosen. Then a function changes on it, and produces a new the chromosomes won. If it is not a new of chromosome, of chromosome of previous used in the next phase is Nikzad (2012). Probabilistic approach based on particle swarm algorithm and the formation of communities to optimize their functions. This method first by Kennedy and Eberhart (1995) and a based on the simulation of social behavior and a collective intelligence were presented.

Groups of particles algorithm as a method without any derivative information the spaces and a complicated problems and derive an effective functioning and having a high the convergence speed, strong, flexible leaves. Of Aspects computational systems algorithm and a not expensive cost, even with very modest memory and processors can be found in most home computers, is applicable. Algorithm and groups of particles or flock with an initial population is generated randomly, the beginning and complete the end bet arrives.

The final requirement for the algorithm is performing 100 successive iterations of the algorithm. The use of meta-heuristic algorithms are needed. The algorithm requires every solution of the problem of Initiative of excessive simple form and can be used in programming is coding. Answer codec a significant impact the speed and accuracy every algorithms is Initiative of excessive. Answer a title must be the association spanning between one to one and a answer the question of how to represent the solutions exist. In other words, every answer to the question exactly the same structure is displayed and the display is only one response to the corresponding question. Also, any response must be stored a small memory space. View every Answer is chosen so as operator and neighborhood requirements of the algorithms Initiative of excessive easily be done.

For coding the each selected solution portfolio, from an array of length the number of tasks to be used. This introduction is the fact that what the stock and what weight are selected. Meta-heuristic particle swarm algorithm flowchart is presented in diagram 1. Meta-heuristic algorithm and particle swarm where each particle in is updated by the following formula:

$$X_i(k+1) = X_i(k) + V_i(k+1) \quad (2\text{-}2)$$

The particle swarm meta-heuristic algorithm, initially a population of particles randomly given initial position and velocity.. The best position the particle has so far (P-best) and the best position that the particles now have the whole set (G-best), is calculated at the current stage. Third, the speed and location of every particle in the new stage of formula 1-2 and 2-2, and the final update, the stopping criteria are met, otherwise the algorithm and stops and will run Step 2 again. The purpose of this substitution, proper distribution of information between the local optimum and the global optimum birds. So that the bird route in the direction of use.. If Si, t and Ti, t as birds are considered mid locations, concepts chart below Vit, (Pit-Xit) and (Git-Xit) will map.

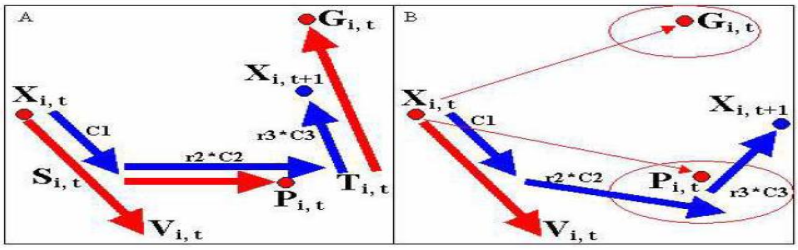


**Figure-1.** View of concepts particle swarm algorithm

At each step of the algorithm and particles for each of the members of the community, given the current status of its members, the position of its members and its position relative to the rest of society, distinct policies to create a new neighborhood for its members to adopt are. Choosing the right policy for the current position of each member of the parameter, select the appropriate policy for the member position relative to other members of the community, and to select appropriate policy parameters with respect to the parameter $FI_i\left(k\right)$ its member. $II_i\left(k\right)$ wil be calculated. Then, according to these parameters distinctive policy is adopted. For each community the parameter $FI_i\left(k\right)$ is obtained as follows*:*

$$FI_i\left(k\right)=1-\frac{f\left(X_{ik}.\left(k\right)\right)}{f\left(X_i\left(k\right)\right)} \tag{2-3}$$

Where the objective function objective function value of each solution, here is the latest completion time are important. If it is $i=i_k^*$, the second available as the value $FI_i\left(k\right)$ is equal to zero. Possible factor in the case of $f\left(X_{ik}.\left(k\right)\right)$ is equal to zero, will be defined according to the problem would be impossible. Therefore, it would be $0<FI_i\left(k\right)<1$. Different politics according to the quantity of $FI_i\left(k\right)$ is as follows*:*

$$MP_i^{current}=\begin{cases} Apply\ transportation & FI_i\left(k\right)=0 \\ Apply\ insertmutation & 0<FI_i\left(k\right)<1 \\ Apply\ cross-over & F<FI_i\left(k\right)<1 \end{cases} \tag{2-4}$$

$$MP_i^{current}=\begin{cases} Apply\ transportation & FI_i\left(k\right)=0 \\ Apply\ insertmutation & 0<FI_i\left(k\right)<1 \\ Apply\ cross-over & F<FI_i\left(k\right)<1 \end{cases}$$

*Exchange mutation operator used above, the randomly selected location and then actually doing the work of the position to another position in the matrix of the* exchange is kept in the answer, the exchange of. *insert* The location of the mutation operator randomly selected and then it is transferred to another position to another position within the. Cross-Over Mutation operator is also the location of a randomly selected set of neighboring solutions that are exchanged and those with the best deals. The selection policy is based on the location of other members of the human motion to generate a predefined neighborhood of attempted to define batch size as category $(X)$. For example, from $4X+1$ in each category, the number $X+2$ is the next category is $2X+1$. In this case a bird in a batch is identified based on the mating combination, or should the best in each category occur (Raie and Beigi, 2010).

Because of the way only able to generate random answer will examine the problem space and therefore cannot be completely sure that it was the general optimality. In other words, the number of repetitions is limited, only local optimality can be achieved. Therefore, it is necessary to determine the conditions, the total amount assessed optimality. The boundaries specified performance is presented in diagram 2.

Accordingly, when the risk is minimal, portfolio return for portfolio selection and great value during these two together near the value of each selection is also more balance of the value of a much pass specifically, the increased risk to be addressed. In other words, in this case, compliance risk, high return on the investor for a greatly increased - increased.

To evaluate the performance of the proposed algorithm and, $\lambda$ to determine the amount and on the other hand, continuous changes and experimental performance of each algorithm and, the amount of this difference is unknown. To this purpose, level $\lambda$ than any of the previous motion be 0.05 increase in the number of 20 different tests are carried out for $\lambda$ .


**Figure-2.** Standard efficient frontier

## 3. EMPIRICAL RESEARCH LITERATURE

In recent years, the portfolio optimization is considered in empirical studies, however, using the technique of aggregated particles in comparison to other methods of combinatorial optimization

under consideration is. In this case, Peng-Yeng and Wang (2006), in their study, using the particle swarm nonlinear resource allocation efficiency of this method have been compared with genetic algorithm. Overall, these results indicate that the particle swarm algorithm and is more efficient than genetic algorithm.

The results Chiam *et al.* (2008), combining genetic algorithm and optimization techniques based on particle mass Memetics algorithm and in which the technique only applies to on the answers obtained by genetic algorithm, and show that using this algorithm, groups of particles portfolio much more efficiently than when the algorithms are applied separately. Tofeng Chang (2009), in other studies, the efficiency of groups of particles optimization problem constrained portfolio during the period from 1992 to 1997, has been tested. The results of this study suggest that this technique is very successful in portfolio optimization.

Studies conducted in-country stock portfolio optimization heuristic optimization technique has received less attention. In this regard, Raie and Beigi (2010), in their study, the stock portfolio optimization problem using Particle Swarm moves in 20 companies in Tehran Stock Exchange during the period 2006-2008 is discussed. Overall, these results indicate that the method of Particle Swarm Optimization method has been successful Portfolio restrictions. Nikzad (2012), in other research, genetic algorithms, Simulated Annealing Memetics and the portfolio optimization of the shares on the stock exchange, has been compared. Overall, the results indicate that the proposed algorithm is capable of Memetics ¬ portfolio optimization problems with risk criteria, taking into account the limitations of integer for the number of stocks in the portfolio to solve. The results show that the algorithm Memetics in all cases studied, the best results obtained by Genetic Algorithm and Simulated Annealing are presented.[1]

## 4. RESEARCH METHODOLOGY

The present study, using genetic algorithm and groups of particles optimization portfolio and compare the results, in terms of risk and return. For this reason, financial data, 30 companies in Tehran Stock Exchange regarding financial intermediaries, non-metallic mineral Other products, automobile and parts manufacturing during the period 2007 to 2012 with the aim of collecting and identifying the optimal portfolio consists efficient frontier investment to identify and establish the optimum portfolio using the heuristic algorithms are studied.

The determination of the portfolio, in the form of study models, assumptions, and there are several variables that must be considered. Markouitz model, all choices are separate and independent from each other they are observed. Also, every choice has a defined benefit and could be due to differences with the other options outlined. Each of the designs can range from zero to 100 percent of the capital stock of its design capacity of one hundred percent of their total weight must be

[1] 80 percent were caused due to the influence of market selection and combination of these two sets and aggregating them, 30 companies have been selected

selected to form a complete basket of. The first model of Markowitz mean-variance risk measure for measure ¬ bid. Classical model mean-variance is as follows:

$$\begin{aligned} &Min\sum_{i=1}^{k}\sum_{j=1}^{k,j\neq i}x_i x_j \sigma_{i,j} \\ &S.t:\sum_{i=1}^{k}x_i \mu_i = R \\ &\sum_{i=1}^{k}x_i = 1 \\ &0 \le x_i \le 1 \end{aligned} \qquad (3\text{-}1)$$

$x_i$ In which the amount of capital held in the plan $\mu_i$ i, i, and the expected value per unit of the scheme $\sigma_{i,j}$ is the variance between the two designs i and j. In this model, in line with the objective function, the objective is to minimize the risk of. Risk in this case there is a large divergence between selected elements in the basket. The main difference is that the display is the standard deviation; the more increases the risk of. Fernandez and Gomez (2007), the Markowitz model with the addition of upper and lower limits for variables modified models mean - variance components presented tying $(CCMW)$. General form of the model of Fernandez and Gomez, to as follows:

$$\begin{aligned} &Min\sum_{i=1}^{k}\sum_{j=1}^{k,j\neq i}x_i x_j \sigma_{i,j} \\ &S.t:\sum_{i=1}^{k}x_i \mu_i = R \\ &\sum_{i=1}^{k}x_i = 1, \varepsilon_i \le x_i \le \xi_i \end{aligned} \qquad (3\text{-}2)$$

Where the first capital of making the scheme i $x_i$ , expected value per unit of the scheme i $\mu_i$ , $\sigma_{i,j}$ degree variance between project i and j, $\varepsilon_i$ the lower limit for the selected stock of i, $\xi_i$ and the upper limit for the selected stock of the i's. In this model, the first model is established Mfrzvat condition but in fact - will have a more realistic. In this situation no longer is a plan ever wanted to buy or plan to buy some did not. In these situations a certain extent should be considered as the main range. The main disadvantage of this method is limited, failing to optimize portfolio selection problem under the constraint of integer constraints.

Because in the real world and the real financial decisions often require investors to determine the exact number of assets in their portfolio.Customer risk models entering the integer restrictions,

the model closer to the real world and thus also solving practical and useful decisions in the hands of the investors. Login restrictions programming integer programming and nonlinear discrete space continuous search space will become. This situation causes Kuadratyk integer linear programming is an open compound. Integer restrictions are added to the model as follows:

$$\begin{aligned} &Min\lambda[\sum_{i=1}^{k}\sum_{j=1}^{k,j\neq i} z_i z_j x_i x_j \sigma_{i,j}] - (1-\lambda)\sum_i z_i x_i \mu_i \\ &St: \sum_{i=1}^{k} x_i = 1 \\ &\sum_i z_i = K \\ &\varepsilon_i z_i \le x_i \le \xi_i z_i, z_i \in [0,1] \end{aligned} \tag{3-3}$$

In model $\lambda$, the risk of taking or risk aversion shows. In this model, the Type $\lambda$ in the objective function, and returns both Myarrysk Drtab goal arrived and while Hdaqlsazy risk, maximizing efficiency is considered. In fact, it is a weighting the parameter whose value varies in the range of $[0-1]$ values reported by the investor to the risk or return are applied. In other words, the higher $\lambda$, the more important efficiency and simultaneously reduce the quantity $1-\lambda$ weight can lower the risk minimization objective. In the above model, the necessity for investment also proposed personality and can be expected to have different impacts to be considered an investment. If a person is risk averse, given the importance of risk reduction and ( $\lambda$ ) will be an amount equal to one. On the other hand, the venture capital more, this quantity tends to zero so that the second term of the objective function given more power and look profit maximization is the max.[2]

The genetic algorithm and the algorithm and moves each portfolio as a chromosome as a bird flock or group, particles are considered to be. In algorithm and, the population, the number of chromosomes in the genetic algorithm and the number of birds, algorithm and handles the movement of birds, 100 was considered and the number of iterations in this algorithm and constant and equal to 100 iterations are considered. On the other hand, the selection probability of a chromosome in a

[2] In developing these models to investigate new methods of semi variance, as well as one of the finance literature has been examined:

$$Min(1/T)\sum_{t}[\min(R_{pt}-B,0)]^2$$

Where $T$, the total number of plan $R_{pt}$ and $B$, the rate of return expected rate of return on the selected portfolio is derived from a comparative study. The use of semi-variance, investor's expectations. What is true is that investors with a forecast of investment or entering They are the result of previous experience, or his thinkin. In this mode of operation is the minimum mean square differences,

genetic algorithm as an elite equal to 5 percent probability Get a jump of 15 percent and the remaining 80 percent will be determined by the usual pair of algorithm and moves In the flock of birds in groups of for more than 10 is considered. Algorithm and moves in the flock of birds in groups of for more than 10 is considered.For each group, the leader A is determined by the successive iteration, birds constantly adjust their behavior to the group's first president and chairman of the group with the best will coordinate bird.

## 5. ANALYSIS OF EXPERIMENTAL RESULTS

The results of the estimation of the efficient frontier of particle swarm algorithm and genetic algorithm in the form ¬ A Markowitz model, mean - variance optimal portfolio of restricted and customer risk models, which are presented in Figures 3 to 6 show that the algorithms particle swarm and genetic stocks with good accuracy can solve the problem of portfolio optimization . genetic algorithm and particle swarm algorithm to the efficient frontier obtained less. The model mean - variance bound, the addition of weight equal to one Brmhdvdyt investment limits for investment limit in terms of the genetic algorithm is more precise and efficient frontier between the efficient frontiers obtained with the standard genetic algorithm is low.

In contrast, the limited number of customer risk model asset portfolio will be added to the model, groups of particles algorithm and is more precise and distance from the efficient frontier efficient frontier obtained with the standard groups of particles algorithm and genetic algorithm is less than the efficient frontier is obtained.

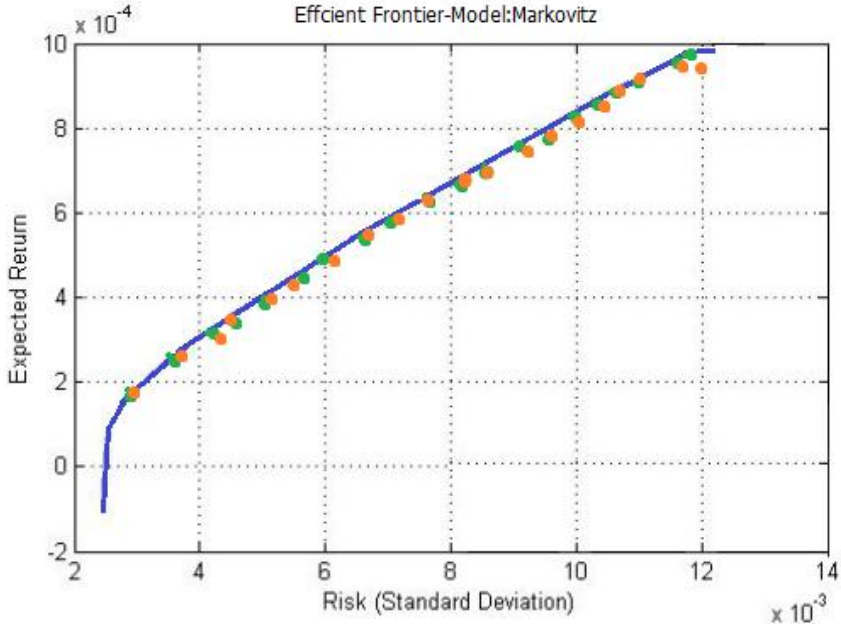


**Diagram-3.** Standard efficient frontier and the performance of groups of particles algorithm and and genetic ¬ Markowitz model

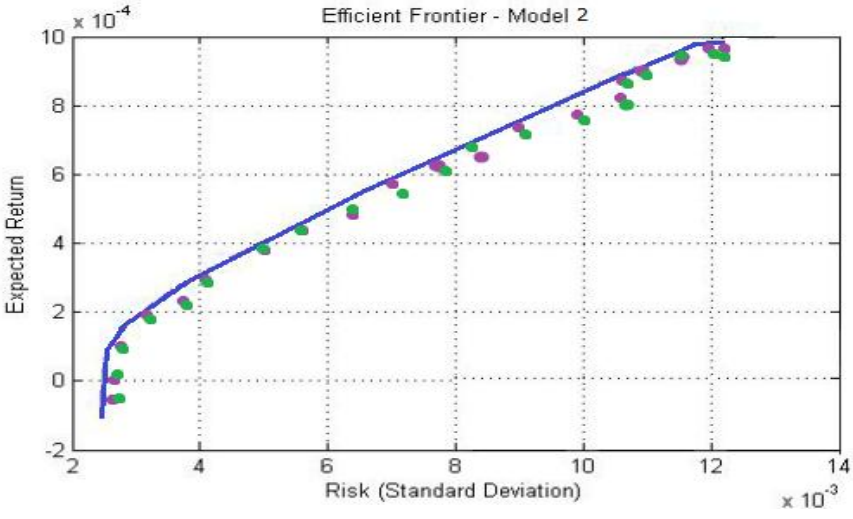


**Diagram-4.** Standard efficient frontier and the performance of groups of particles and genetic algorithm and in the model ¬ mean - variance bound

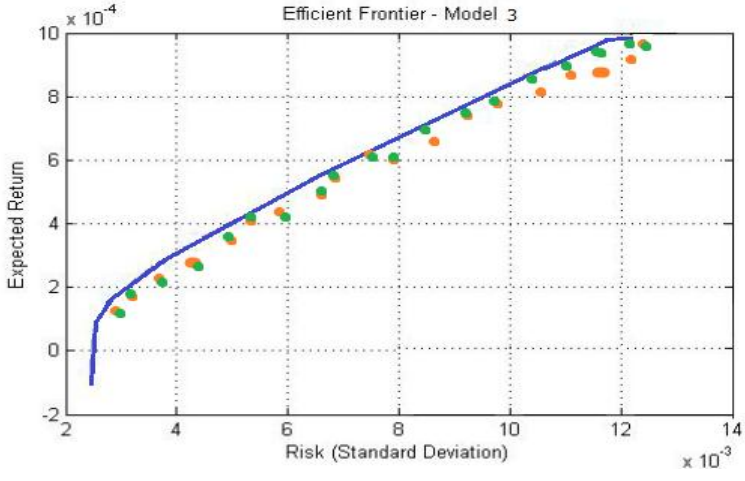


**Diagram-5.** Standard efficient frontier and the performance of groups of particles algorithm and and genetic ¬ customer risk models

In other words, most observations reflect the fact that in the problems are smaller and more lightweight genetic algorithm performance and complexity with increasing sample size, groups of particles algorithm and have better performance. Accordingly, votes to be superior to genetic algorithm in the two models and the model of Markowitz mean variance was constrained. The particle swarm algorithm is superior to the genetic algorithm in the third model. Be compared with the pre prediction algorithm and is presented In the Table 1.

In this table, the performance of each algorithm and in the terms of objective criteria and is considered the difference in the final period. In other words, the main criterion for evaluating algorithms based on the belief that each algorithm and with respect to the previous period, to what

extent it has been able to determine a basket in the final period, to make maximum profits. For this purpose, the data set selected for the basket ¬ final period, the percentage of each share in the basket so that maximum benefit is derived if it is.

**Table-1.** Comparison of the performance of algorithm in prediction

| groups of particles algoritm | | | | | | Genetic Algoritm | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Customer risk models | | Model mean- variance constrained | | Markowitz model | | Customer risk models | | Model mean - variance constrained | | Markowitz model | |
| Difference with the the Courses | The objective function | Difference with the the Courses | The objective function | Difference with the the Courses | The objective function | Difference with the the Courses | Difference with the the Courses | Difference with the Courses | The objective function | The difference with the Courses | The objective function |
| 0.046 | 394 | 0.028 | 324 | 0.044 | 214 | 0.093 | 394 | 0.106 | 373 | 0.055 | 302 |
| 0.05 | 227 | 0.016 | 215 | 0.086 | 213 | 0.082 | 227 | 0.048 | 224 | 0.088 | 224 |
| 0.076 | 225 | 0.042 | 211 | 0.077 | 200 | 0.007 | 225 | 0.079 | 225 | 0.013 | 225 |
| 0.061 | 283 | 0.018 | 283 | 0.017 | 279 | 0.082 | 283 | 0.023 | 265 | 0.045 | 212 |
| 0.052 | 215 | 0.013 | 213 | 0.087 | 213 | 0.077 | 215 | 0.062 | 212 | 0.096 | 211 |
| 0.054 | 360 | 0.042 | 325 | 0.096 | 290 | 0.081 | 360 | 0.085 | 341 | 0.071 | 240 |
| 0.08 | 213 | 0.049 | 207 | 0.032 | 204 | 0.1 | 213 | 0.049 | 208 | 0.064 | 200 |
| 0.042 | 267 | 0.013 | 247 | 0.018 | 226 | 0.004 | 267 | 0.042 | 259 | 0.073 | 245 |
| 0.044 | 202 | 0.091 | 202 | 0.015 | 202 | 0.083 | 202 | 0.105 | 200 | 0.1 | 200 |
| 0.05 | 207 | 0.065 | 203 | 0.037 | 203 | 0.038 | 207 | 0.046 | 203 | 0.075 | 200 |
| 0.014 | 281 | 0.066 | 237 | 0.095 | 222 | 0.082 | 281 | 0.067 | 278 | 0.024 | 201 |
| 0.075 | 311 | 0.08 | 263 | 0.053 | 232 | 0.102 | 311 | 0.11 | 248 | 0.107 | 223 |
| 0.075 | 389 | 0.008 | 310 | 0.002 | 308 | 0.022 | 389 | 0.095 | 381 | 015/0 | 326 |
| 0.051 | 226 | 0.02 | 214 | 0.055 | 202 | 0.064 | 226 | 0.039 | 225 | 0.082 | 221 |
| 0.064 | 324 | 0.037 | 287 | 0.095 | 249 | 0.037 | 324 | 0.067 | 287 | 0.003 | 238 |

**Source:** Findings

Moreover, the estimated objective function in the each groups of particles algorithm and genetic algorithm based on Markowitz model, mean - variance bound and client risk model is presented in the diagram 6.

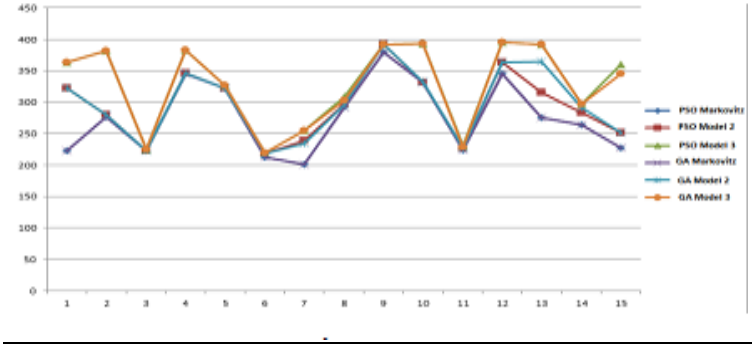


**Diagram-6.** To estimate the objective function of each group of particles algorithm and genetic algorithm

These results also show that the genetic algorithm model, and model Markowitz mean - variance bound is better than the groups of particles algorithm and. The algorithm and handles the movement of birds in the third model results closer to optimality offers. The third model Estimated error rate is presented In the Table 2.

**Table-2.** Comparison of mean and variance of the error of genetic algorithm and groups of particles algorithm and

| Type of model | groups of particles Algorithm | | Genetic Algoritm | |
|---|---|---|---|---|
| | The average | The variance | The average | The variance |
| Markovitz | 0.056 | 0.0012 | 0.058 | 0.00092 |
| The average - variance constrained | 0.043 | 0.00071 | 0.062 | 0.00064 |
| The customer risk | 0.057 | 0.00045 | 0.044 | 0.00086 |

## 6. CONCLUSION

In this study the, the genetic algorithm and particle swarm algorithms based on three models Markowitz mean - variance bound for solving customer risk and models portfolio optimization ¬ studied and has been evaluated. A total these results suggest that in constrained mean-variance and models Markowitz model, the efficient frontier between the efficient frontier obtained with the standard genetic algorithm to the groups of particles algorithms, was lower, while the differences in the standard efficient frontier algorithms particle swarm algorithm and particle swarm model is a third less risk model, the client has a good performance. Dominant of the research on groups of particles algorithms and genetic algorithm in comparison with other studies also confirmed that the concept of groups of particles algorithms is that it can be well on rapid and accurate analysis of the issues that genetic algorithm cannot be applied. Cause of the claim, there must be a group attitudes to similar cases previously considered.

In response to a possible hypothesis optimization ability of groups of particles algorithm can be said, the optimal portfolio selection problem increases with greater complexity constraints, it is not only appropriate an method but to be the suitable the complexity of dealing with their own show. In other words, most observations reflect the fact that the problems are smaller and lighter than the ¬ with the increasing complexity and size of the genetic algorithm, groups of particles algorithms have better performance. Groups of particles algorithms in the third model, in comparison with genetic algorithm, the faster will draw efficient frontier, although this algorithm as compared to the classical models Markovitz and Mean-Variance more tender time variance bound for algorithms is necessary. The following suggestions can be used to evaluate data in order to improve the tools of financial analysis and can be expressed as:

*1. Development of other innovative methods such as Ant colony algorithm, electro-magnetism, and harmonies of music, Memetics algorithms and Simulated Annealing technique to study the optimal portfolio.*

*2. Adding catalog others investment restrictions investment of the mathematical model and its solution using innovative methods*

*3. Use of algorithms studied in this research, optimization and comparison of companies in the Stock Exchange Market and applies of these results to guide investors.*

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